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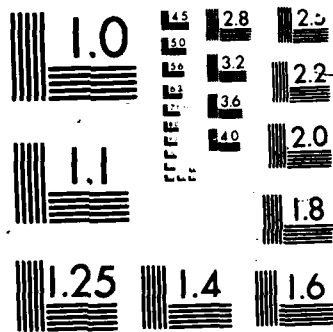
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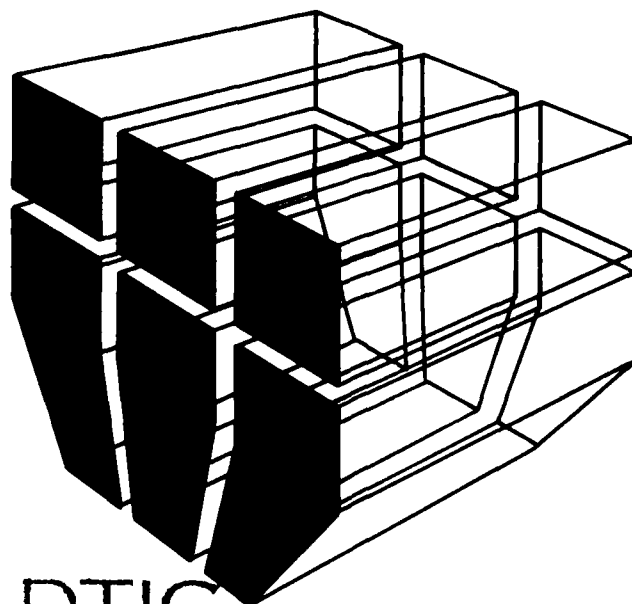
August 1986

Advanced Video Disc/Laser Disc Technology Applications

# Applications of Videodisc Technology to Combat Engineering

by  
**Robert B. Blackmon**  
**Michael J. Fuerst**

This report briefly describes interactive videodisc technology and many of the technology applications already fielded or under development. It also discusses potential videodisc technology applications that could improve combat engineering operations, such as use of computer-based training.



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## FOREWORD

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COL Norman C. Hintz is Commander and Director of USA-CERL, and Dr. L. R. Snaffer is Technical Director.



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# **APPLICATIONS OF VIDEO DISC TECHNOLOGY TO COMBAT ENGINEERING**

## **1 INTRODUCTION**

### **Background**

During the past 6 or 7 years, videodisc technology has become available that makes it possible to store large amounts of textual, video, and audio information. With proper programming, many videodisc players permit random access from individual sections of videodiscs. With the appropriate software and interface cards, microcomputers connected to videodisc-playing devices can control the access of information, often in response to user inputs. This technology has many applications to both computer-based training and retrieval of information from large databases. Furthermore, additional improvements to videodisc and other optical storage technology are expected to become available in the next several years that will make use of this technology even more desirable.

The Army has made a commitment to implement videodisc technology by establishing the Army Materiel Command, Project Manager Army Communicative Systems (AMCPM-ACS) at Fort Eustis, VA, and by developing a wide range of videodisc-based training courses oriented primarily to people and organizations that perform tactical missions. Therefore, to optimize use of the resources committed to this technology, it is appropriate that the Army seek additional applications for videodisc technology.

### **Objective**

The objective of this study is to review the Army's use of the interactive videodisc technology and to identify unexplored applications to theater of operations activities.

### **Approach**

Videodisc technology state of the art was determined through a series of interviews and system demonstrations held with Army personnel and private companies involved in developing and procuring optical discs and their related hardware and software. The technology's identified capabilities were then compared to needs of the combat engineering mission in the theater of operations, with primary interest in construction and maintenance of base camps, base operations, and reducing the volume of required administrative materials.

### **Mode of Technology Transfer**

It is recommended that the information in this report be used as a basis for further development of videodisc applications for the theater of operations.



## 2 OVERVIEW OF VIDEODISC TECHNOLOGY

Interactive videodisc technology uses a reflective metalized plastic disc on which laser light is reflected and decoded into audio and video signals. The term videodisc is often used synonymously with optical disc, especially when referring to applications involving storage of pictures, rather than data. In the most common commercially available technology, information is stored as tiny pits (about 0.5 micron in diameter) and pressed onto a transparent substrate with a reflective coating. Approximately 12 to 15 companies possess manufacturing methods and processes to master and replicate such discs. A videotape of the desired contents of the disc must be submitted to one of these firms. Due to initial setup charges, creating the first copy of the disc may cost between \$2000 and \$5000; however, additional copies cost less than \$20. Once written, such discs cannot be erased and are limited to use for read-only applications.

Discs are available in several formats. The most common are 8 to 12 in. (203.2 to 304.8 mm) in diameter and can store 54,000 pages of text or images on each side, including two independent audio tracks. The disc can store 30 minutes of full-color television with two-track audio. With audio compression techniques, 150 hours of audio can be stored on each side. Still-frame video with extended audio can also be stored. In addition, discs can be used to store data. Based on recent product announcements, a 5.25-in. (128.63-mm) diameter disc (dubbed compact disc, or CD) can store 500 to 800 megabytes. For single units, a videodisc player and the necessary interface card for a microcomputer are available for \$1500. The monitor to display video images with superimposed computer output costs another \$1000.

Videodisc technology can be used to store data for computers. For this application, the term optical disc, rather than videodisc, is used. An optical disc (depending on size of the disc and format used) can store 200 to 3000 megabytes of data. (A byte is roughly equivalent to one typed character.) However, unlike floppy and fixed drives typically found on computers, data cannot be repeatedly written on optical discs. Read-only optical discs have a large database encoded on them, from which a computer with the proper interface hardware and software can search and then retrieve data. For example, Grolier Encyclopedia now offers its American Encyclopedia on optical disc. Business and scientific data bases will soon become available. For read-only applications, the term CD-ROM (for compact disc read-only memory) is used. CD-ROM drives currently sell for \$300 to \$600 in large quantities, and \$1200 to \$1500 in single units. The most typical sizes for CD-ROM drives and discs are 4.7, 5.25, and 12 in. (119.4, 133.4, and 304.8 mm) in diameter. Write-once, read-many (WORM) optical disc drives are now available from several manufacturers and start at \$2500. Data can be written on optical discs with such drives, but revising the data requires rewriting the data on a different portion of the disc. Prototypes of optical disc drives that can write, revise, and read data as often as desired have been announced, but none are expected to be available until late 1986 or early 1987.

Most of the Army's technology applications involve training and equipment simulation. The typical hardware configuration includes a read-only videodisc player which is interfaced to a microcomputer having two floppy disk drives. The video and audio information resides on the videodisc; a floppy disk contains a program to control the sequence of images and audio retrieved from the videodisc (which may depend on the user's responses to prompts or questions). The program also defines computer graphic images that can be shown as overlays on the various video images. The most popular configurations in Army use are (1) a Sony SMC-70 microcomputer and a Sony videodisc player or (2) an Apple II computer with any of several videodisc players. Systems having

a videodisc player that interacts with a microcomputer in this way are known as Level III systems. Users interact with the system through one or more input devices such as a keyboard, touch screen, joystick, or mouse.

While Level I and II systems are not commonly used by the Army, both are defined below to describe some of their applications. Level I systems contain only a videodisc player that plays back the information in the order it was recorded. Typical applications are for sales and other video presentations. Level II systems contain a videodisc player with limited programming capabilities for random access of information. These programs are stored either on the videodisc or in a limited memory within the videodisc player. Applications requiring only simple multiple-choice responses from the user are amenable to Level II systems. A computer becomes involved only in Level III systems.

### **3 APPLICATIONS OF VIDEO DISC TECHNOLOGY**

#### **Nongovernment Applications**

To assess videodisc capabilities and possible applications to Army programs, several examples of videodisc use within private industry were investigated. Applications similar to those described here may be useful in Army operations and training programs.

Digital Video Corporation has developed an ordering process for the Westinghouse Steam Turbine Division. Westinghouse was faced with supplying parts to worldwide users having different native languages, and with a great deal of system documentation on all turbines. Further complicating the supply problem is the fact that the turbines are essentially custom-designed for each application. Few parts are stockpiled for quick delivery, being manufactured only to satisfy orders.

First, a technique was developed to display the existing series of equipment breakdown drawings on the video screen and a narrative description on a companion screen. The video screen initially displays the entire turbine, denoting each part/assembly that can be individually addressed with a yellow line that leads to a touch point. A light pen or touch screen is used to designate the desired component. Smaller parts/assemblies can be selected from successive screens. The companion screen lists the displayed parts, along with their costs and delivery times.

The computer accumulates the ordering information as it is generated; it then electronically transmits the completed message to worldwide headquarters for processing. Westinghouse soon realized that their supply managers could probably use the system's interactive capabilities to help order parts, and extended the system to allow field users to call supply managers. The computer automatically calls up the same screens for both the field user and the supply manager, allowing both parties to discuss the order without fear of misunderstanding. Supply managers could also ensure that field users were using the most recent parts catalogues. Either party could control both sets of hardware. When images on one set are changed, the other set follows automatically.

The New York University Lawyering Skills Interactive Video-Computer Experiment (NYULIVE) teaches law students the rules of evidence by means of a mock trial shown on a videodisc. The student must learn to object at the proper moment (when the objectionable words are spoken)--neither too soon (before it's clear the objectionable evidence is to be presented), nor too late (after the jury's exposure to the objectionable material).

The video screen displays a trial in process. When the student objects by touching the screen, the sequence stops, and the judge requests the basis for the objection. The student can type in an appropriate response. The program operates at three levels of difficulty, each requiring more specific or detailed responses from the student.

The program also has four levels or branches. If a student's objection is sustained, the opposing attorney tries another method to get the evidence entered. After objecting, but before stating the grounds of the objection, the student may switch the program to research mode and consult any of several references stored on the disc. The program allows the student to leave questions and comments for the professor, and also informs the student of the number of missed opportunities for objection and the number of improper objections made. Development of such a program costs approximately \$100,000; however, costs may vary widely, depending on complexity, from less than \$2000 to over \$150,000.

General Motors has used videodisc technology to develop training programs for sales and repair personnel, and to maintain parts catalogues.

### **Army Applications**

AMCPM-ACS is responsible for integrating videodisc technology for Army use and for developing applicable Army standards. AMCPM-ACS and the Army Communications Electronics Command (CECOM) are procuring for eventual distribution throughout the Army approximately 30,000 integrated microcomputer-controlled, interactive videodisc systems, which can operate as Level III systems with higher-level data and audio storage capabilities. Specifications for the system, known as Electronic Information Delivery Systems (EIDS), require a new configuration of equipment that combines the videodisc player/microcomputer into one subsystem (the VDP/MS) and provides several display options. The equipment will incorporate the best features of commercially available Level III systems and of several prototypes previously submitted by manufacturers. Delivery of the first system is expected in the spring of 1987, at a price of \$4000 to \$5000 per system. The system will be used as a workstation for training.

AMCPM-ACS has advocated the Sony configuration as an interim EIDS. In support of this, AMCPM-ACS has developed the Program Management System (PMS), a software package to manage development of the videotape from which the videodisc is written and to "author" (i.e., write) the program to be stored on the floppy disk. PMS will be converted to run on the final version of EIDS. Any Army training programs developed with PMS software on the interim EIDS will be easily converted, with AMCPM-ACS support if necessary, to run on the final EIDS. The authoring portion of the PMS software lacks some of the more advanced features of commercially available authoring software. However, since the interim EIDS, the final EIDS, and future hardware systems must be transportable, AMCPM-ACS expects the PMS software to become the standard Army software for managing and authoring videodiscs and intends to upgrade PMS software after procuring the final EIDS. Several private firms undoubtedly will convert their own authoring systems to run on the final EIDS.

AMCPM-ACS is currently researching and developing performance specifications for a Miniaturized Electronic Information Delivery System (MEIDS). Like EIDS, each MEIDS will consist of a computer, a display, and a high-capacity data storage medium. The system will be used to deliver technical information (manuals, regulations, etc.) to personnel performing functions such as maintenance, repair, and construction in the field and the theater of operations. As such, MEIDS must be militarized (i.e., very rugged),

lightweight, and no larger than a large book. However, current technology cannot provide either small, lightweight militarized optical drives or thin displays of adequate resolution. Thus, AMCPM-ACS does not expect MEIDS to be operational until 1992. However, technology does exist that could provide an interim MEIDS within 2 years. Over the next 12 to 15 months, AMCPM-ACS plans to award contracts to develop the interim MEIDS and the target MEIDS. It is expected that two or three firms will construct prototypes of each system.

Several years ago, the Defense Advanced Projects Research Agency (DARPA) developed a Voice Interactive Maintenance Device (VIMAD). An operator would wear a 1.5-lb (0.6-kg) headset containing a microphone and a small TV display tube, viewable from one eye, with lenses to make the picture appear to be 6 by 8 in. (150 by 200 mm). The TV receiver and a two-way FM radio receiver were contained in another 1.5-lb (0.6-kg) package worn around the waist. The voice signals were sent to a computer that had a voice recognition system capable of recognizing 20 words, and could respond by transmitting video or audio instructions to the wearer. Thus, a technician performing maintenance in a physical position or location not conducive to consulting a manual could get assistance when needed.

The Army is currently developing the All Source Analysis System (ASAS) to provide and analyze intelligence information in the theater of operations. The system will consist of a minicomputer and several types of workstations. Videodiscs and players at the workstations will display maps of various scales on which graphics can be superimposed. For example, the graphics can locate men or materiel, and can display line-of-site information, target acquisition information, or safe drop zones.

The Engineer Topographic Laboratory has submitted a proposal to develop a ruggedized\* and TEMPEST-certified\*\* videodisc drive for use in various Army systems, such as armored vehicles or robotic vehicles, and to support the Digital Topographic Support System.

For several years, Fort Benning, GA, has used Videodisk Interpersonal Skills Training and Assessment (VISTA), a videodisc-based course to teach leadership skills to second lieutenants during role-playing workshops. For example, participants can watch a scenario in which an officer must discipline a subordinate. The participants then choose a disciplinary method from among several alternatives offered, and their choice is then acted out on the screen.

The Army Research Institute (ARI) at Fort Benning has developed a Multipurpose Arcade Combat Simulator to provide training in the use of several types of rifles and grenade launchers. These programs currently reside on a Commodore computer, but ARI hopes to implement them on a videodisc.

Several operations and maintenance manuals for the Patriot Missile System have been converted to videodisc. The pages have been indexed and outlined so that a user can quickly find the desired information.

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\*One capable of surviving moisture, vibration, rough wear, etc.

\*\*Does not emit signals that can be detected by electronic security.

A videodisc course has been developed by the Training Technology Center at Fort Belvoir, VA, to train personnel in mine field breaching. The course has been implemented on an Apple Computer and Pioneer videodisc player. By the fall of 1986, the course will be available on the Army Standard System.

Using a technique known as surrogate travel, the Army has developed videodiscs to familiarize personnel with a facility or location without having to visit it. With this technique, several hundred to several thousand photographs are taken of the location, with sufficient overlap so that the "traveler" sitting at the videodisc workstation can specify commands such as "move forward," "move backward," "turn" (left or right), or "enter the next room." The photo (or sequence of photos) retrieved from the videodisc in response to the command will simulate the step or continuous motion, and overlap enough of each preceding picture so that the traveler maintains orientation. Often, the traveler can switch between the photos and a map of the facility on which the current location is marked, and thus maintain a global perspective. The programming must link the photos and maps properly. Surrogate travel videodiscs and programs have been developed to familiarize personnel with overseas embassies and ambassadors' residences, and with routes to be used from U.S. military bases to ports during mobilization. Surrogate travel has also been used in videodisc-based training courses to teach map reading for armored vehicle navigation and to teach occupation techniques (e.g., where to establish watchposts).

The Defense Mapping Agency has placed many of its maps of critical areas on videodiscs for use in various Army systems.

In Europe, the Army has fielded several hundred MICROFIX workstations that consist of a TEMPEST-certified Apple computer and a Pioneer LDP1000 videodisc player. These are used mostly for intelligence applications.

U.S. Army Training and Doctrine Command schools and special activities have completed more than 4300 hours of videodisc-based training, and have programmed more than 6000 hours for FY86-87. Participants include Air Defense Artillery School, Armor School, Aviation School, Aviation Logistics School, Chemical School, Command and General Staff College, Chaplain School, Language Institute, Engineer School, Field Artillery School, Infantry School, Intelligence Schools (Forts Devens, MA, and Huachuca, AZ), Military Policy School, Ordnance Missile Munitions School, Quartermaster School, Signal School, Sgt Majors Academy, Soldier Support Center, Special Warfare Center, and U.S. Military Academy.

So far, the Army has not applied videodisc technology to engineering functions, such as facility construction, maintenance, operations, and support; however, based on analysis of current military experience and commercial applications, the Army may also be able to apply videodisc technology in several of these areas. The following are examples of possible uses in engineering functions.

1. Many of the field manuals and other reference manuals now carried into the theater of operations may be able to be replaced by optically stored versions. Periodic updates could be issued to replace obsolete disks. Benefits would be reduced shipping volumes, increased accessibility to guidance and requirements, and elimination of document maintenance cost and search time.

2. Catalogues of spare parts and materials could be stored optically to avoid confusion between the requestor in the theater of operations and a distant supplier. Both parties would have access to the same catalogue (e.g., videodisc) and could focus on the

correct part by looking at a series of photographs of the equipment. When this technique is shown commercially to be cost-effective, it could be incorporated into the Army supply system.

3. Videodisc technology may be used to provide readily accessible training or instructions to technicians who must repair and maintain buildings and installed equipment, including all base camp facilities and utilities systems, in the theater of operations. The need for such materials is very critical in the theater of operations due to the lack of a large, experienced maintenance and repair labor force.

4. Use of videodiscs could replace the Army Facility Component System (AFCS) materials, such as drawings, materials lists, and data related to base camp construction.

#### **4 CONCLUSIONS AND RECOMMENDATIONS**

Applications of interactive videodisc technologies to training in tactical and weapons systems support have been identified; several of these have been implemented, and others are under development. However, engineering functions, such as facility construction, maintenance, operations, and support have not yet been addressed. Relevant engineering applications include:

1. Replacement of many of the field manuals and other reference manuals carried into the theater of operations with optically stored versions.

2. Optical storage of spare parts and materials catalogues.

3. Provision of readily accessible training or instructions to maintenance and repair technicians in theater of operations base camps.

4. Replacement of AFCS materials such as drawings, materials lists, and data related to base camp construction.

Based on the information obtained in this study, the following recommendations are made:

1. Develop a technique for replicating engineering drawings stored on videodiscs to eliminate the need to distribute, manage, and file hard copies of standard construction drawings.

2. Record all AFCS drawings, specifications, and other related documents on videodisc for Army distribution. A single disc, fully indexed, could easily replace all the current documentation. Information on the disc would be much more accessible than on hard copies. Periodic updates would be required to maintain the documentation.

3. Develop maintenance and repair instructions, including parts lists, and maintenance recommendations for all AFCS facilities and installed equipment, and record them on videodisc for Army distribution. This disc would provide reference material to organizations responsible for operating and maintaining facilities in theater of operations base camps, including major field hospitals and supply centers, that have a limited skilled labor force. This series of discs would cover construction, maintenance, and repair of port unloading and material-handling facilities, roads, runways, hardstands, all buildings and their installed equipment, all utilities, and other site-related activities.

4. Use computer networks and videodisc technology to simplify the AFCS ordering system from the theater of operations. The ordering agent would be able to communicate directly with the Continental United States (CONUS) supply point, and both parties would be able to refer to the same catalog when placing orders or trying to solve problems of missing or mismatched parts and components.

5. Investigate the possibility of incorporating videodisc technology into theater of operations supply systems to replace forms, written text, and many written records.

6. Record all field manuals and other reference materials to be carried into the theater of operations on videodisc. These would probably be ideal applications for compact discs. Each functional area would have a Level I compact disc playback unit for storing and retrieving reference materials.

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